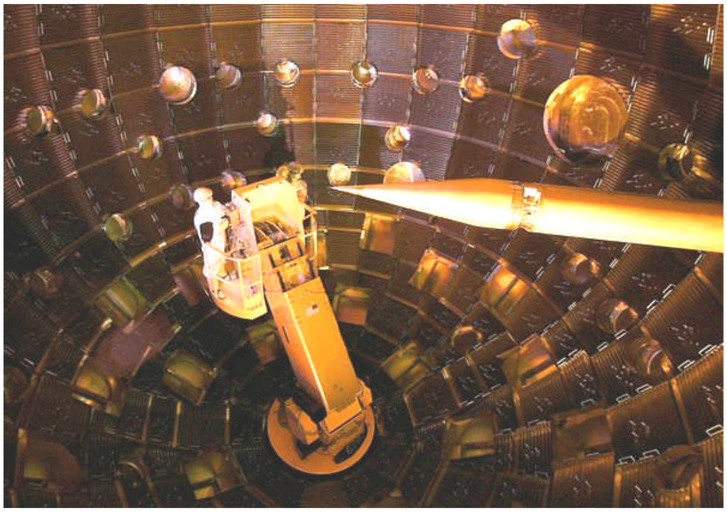
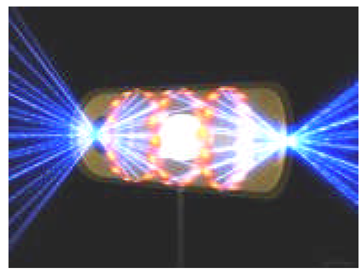
Ker Than
for National Geographic News
Published January 28, 2010

Fusion Power a Step Closer After Giant Laser Blast

Nuclear fusion plant possible within a decade, physicist says.



A pointed "target positioner" (right) in the National Ignition Facility's target chamber held the pencil-eraser-size cylinder used in the fusion experiment. Photograph courtesy Lawrence Livermore National Laboratory, U.S. Department of Energy



Artist's rendering: Lasers penetrate gold cylinder holding BB-size fuel pellet. Image courtesy Lawrence Livermore National Laboratory, U.S. Department of Energy.

Using the most powerful laser system ever built, scientists have brought us one step closer to nuclear fusion power, a new study says.

The same process that powers our sun and other stars, nuclear fusion has the potential to be an efficient, carbon-free energy source—with none of the radioactive waste associated with the nuclear fission method used in current nuclear plants.

(See "Radioactive Rabbit Droppings Help Spur Nuclear Cleanup.")

Thanks to the new achievement, a prototype nuclear fusion power plant could be operating within a decade, speculated study leader Siegfried Glenzer, a physicist at Lawrence Livermore National Laboratory in California.

Glenzer and colleagues used the world's largest laser array—the Livermore lab's National Ignition Facility—to heat a BB-size fuel pellet to millions of degrees Fahrenheit.

"These lasers are pulsed, and for a very short amount of time"—one ten-billionth of a second—"the power they produce is more than all the power generated by the entire electrical grid of the United States" at any given moment, Glenzer said.

The test confirmed that a technique called inertial fusion ignition could be used to trigger nuclear fusion—the merging of the nuclei of two atoms of, say, hydrogen—which can result in a tremendous amount of excess energy. Nuclear fission, by contrast, involves the splitting of atoms.

The laser demonstration means scientists are now much closer to triggering nuclear fusion in a controlled setting—something that's never been done before and which is necessary if fusion is to be harnessed for energy.

Nuclear's Nice Side?

Performing nuclear fusion in the lab requires enormous amounts of laser power, but if perfected, controlled fusion should generate ten to a hundred times more electrical energy than is used to spark the nuclear reactions. Nuclear fusion, after all, is what allows stars to burn for billions of years.

And fusion could be not only powerful but clean and green as well.

Not only does nuclear fusion not produce long-lasting nuclear waste, but fusion could potentially be used to chemically neutralize radioactive pollutants and has been "proposed as a cure to our nuclear waste problem," Glenzer said. Simply put, neutrons released by fusion could rearrange radioactive atoms so they aren't radioactive anymore.

(Related: "'Nuclear Archaeologists' Find World War II Plutonium.")

Nuclear fusion energy is also potentially carbon free, meaning it could be used to generate power without creating any more carbon dioxide gas, which contributes to global warming.

And while fossil fuels, such as oil and coal, and nuclear fission fuels, such as uranium, are limited resources, there's enough nuclear fusion fuel on, in, and around our planet "to power the Earth longer than the lifetime of the sun," Glenzer said.

(Related: "Cheap Oil to Last, 'Doomsday' Fears Overblown, Author Says.")

Gold Fusion

During the laser experiment, the fuel pellet was placed inside a solid-gold cylinder about the size of a pencil eraser, which was hit by multiple laser beams.

The gold cylinder absorbed the laser energy and converted it into thermal x-ray energy.

The x-rays then ricocheted inside the cylinder and struck the fuel pellet from all sides. As the pellet absorbed the x-rays, it heated up—eventually reaching about 60 million degrees Fahrenheit (33 million degrees Celsius)—then collapsed in on itself.

The experiment was designed only to test the lasers' ability to heat the cylinder efficiently. Made largely of plastics and helium, the fuel pellet was not filled with enough actual fuel—chemical variants of hydrogen called deuterium and tritium—to actually trigger nuclear fusion.

Actual fusion, Glenzer said, will occur sometime this year.

With a fully loaded fuel pellet, "the implosion will be like squeezing a soccer ball to the size of a pinhead," he added. "The center of that spherical ball will get so hot that nuclear fusion starts."

Nuclear Fusion Plant by 2020?

If successful, the upcoming nuclear fusion experiment will create two classes of energetic particles: alpha particles and neutrons.

"The neutrons escape and can be used to do things like heat up water"—which could potentially be used to produce steam to drive turbines in an electrical plant, Glenzer said.

"The alpha particles remain trapped [in the burning sphere] and continue to heat the fuel and make it burn," as happens in a star.

Scientists estimate that if they can get to the point where they can burn about five fuel pellets a second, a power plant could continuously generate up to a gigawatt of energy—about what the city of San Francisco is consuming at any given moment.

A working prototype of a such a plant could be built in a decade, Glenzer said.

Cheaper to Burn Cash?

Nuclear fusion researcher Michael Mauel is "very excited" about the recent experiment and said it shows the ignition method works as expected.

But "whether or not we'll have lasers imploding pellets to make fusion energy—it's way too early to tell," said Mauel, who was not involved in the study, which will be published in the journal *Science* tomorrow.

In addition to the considerable engineering challenges involved in ramping up the laser systems for wide-scale use, the cost of the fuel pellets will also have to come down, said Mauel, a Columbia University physicist.

"Each one of these costs between ten [thousand] and a hundred thousand dollars," Mauel said. To use the pellet method to generate nuclear fusion power, "they'll have to cost less than ten cents a piece."